

Agricultural Productivity and Rural Poverty in the Rice-Wheat and Mixed-Cropping Zones of the Punjab

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Abstract

This study was conducted in 2007 based on cross sectional data collected during 2004-05 in order to analyze income sources, poverty status and crop productivity of farmer families in the selected districts of rice-wheat zone (Sialkot, Gujranwala and Sheikhpura) and mixed-cropping zone (Faisalabd, Jhang and Toba Tek Singh) of Punjab, Pakistan. Three-hundred farmers; fifty farmers each district were randomly interviewed for this study. It was found that yields of major crops were 35-50 per cent less than the potential anticipated yields. Moreover, yield gaps for the major crops were almost same across both zones. Use of last year's non-graded crop produce as seed, less than recommended seed use and fertilizers application were the main reasons of yield gaps. Analysis of the sources of income revealed that crop income accounted for about two-third of the total income of farm families. It was estimated that 34% and 28% of the rural farm people were poor in mixed-cropping zone and rice-wheat zone respectively. Poverty gap indices for farm people of mixed-cropping zone and rice-wheat zone were 0.41 and 0.14, respectively. Similarly, income inequality amongst poor in the mixed-cropping zone was more than in the rice-wheat zone. Thus, incidence of rural poverty was more severe in the mixed-cropping zone than in the rice-wheat-zone. Farmers with income above poverty level had more diversified cropping patterns and share of minor crops in their crop income was greater than farmers with income below the poverty level.

Keywords: Income sources, Yield gaps, Major crops

Introduction

In developing countries of Asia, dominant share of their population is living in the rural areas and

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incidence of poverty in these countries is observed higher in rural areas than in urban areas, despite the recent trend of increasing urban poverty (CIRDP, 2010). The dimensions and dynamics of poverty may be extreme as well as relative. Extreme poverty, which threatens people's health or lives, is also known as absolute poverty. Extreme poverty in developing nations, as defined by the international organizations, means having a per capita income of less than U.S. \$ 1 per day (Encarta, 2005). Poverty in Pakistan increased from 26.1% in 1990-91 to 32.1% in 2000-01. Rural poverty in the country became more prevalent than urban poverty after 1993-94 (GOP, 2011). Consumption based absolute poverty indices were reported at 23.1% at overall basis and 28.4% for rural areas (GOP, 2005). There is a phenomenal increase in the poverty incidence in the country in recent years. Official figures of poverty were 23 per cent in year 2008 and 38 per cent in year 2009. Most of the independent researchers, however, put the even higher by three to four per cent (Khan, 2011).

Agricultural development is critically important for poverty alleviation, as 62 % of the population lives in rural areas, directly or indirectly depends on agriculture. Agriculture sector continues to play a central role in Pakistan's economy. It is the second largest sector, accounting for over 21 per cent of GDP (GOP, 2011). Our crop yields are only 30-33% what they are in developed countries and this obviously is cause of rural poverty (Panahwar, 2005). However, national average crop yields of the country are still 56-84% below the demonstrated potentials. For instance, the gap between actual and potential yield of wheat is 72%, sugarcane 74%, rice 84%, cotton (lint) 56%, maize 73%, pulses 86%, and edible oilseeds 77% (Khan, 2004).

The available international literature on the relationship between overall economic growth and poverty reduction is some what ambiguous, whereas the relationship between agricultural growth and poverty reduction is generally positive and much clear. In addition to direct effect of agricultural growth on poverty reduction, there is a much larger indirect effect through the linkages between

agriculture and non-farm growth (Mellor, 2001). Review of literature shows that low crop yields in Pakistan may be attributed to inefficient use of fertilizers, injudicious use of agro-chemicals, poor quality seed, low seed use, conventional sowing method and poor management of agro-practices. Although, technology development and adoption of technical crop production packages are in progress but their pace is quite low. The problem is more severe with the small farmers constrained by meager resources and who are left with little savings for investment on the improvement of their farms. Successive governments in Pakistan have used the state machinery and resources in variety of ways to mitigate the ever daunting and perpetual challenge of poverty, but without much success. Poverty is still burgeoning and expanding. Therefore, this study was carried out to determine poverty status of rural farm families in mixed-cropping zone and rice-wheat zone of the Punjab province with the following specific objectives.

- i. To study the socioeconomic characteristics of the farmers.
- ii. To analyze the income sources and determine the poverty status of rural farm families.
- iii. To find out input use levels and to determine yield gaps for major crops and to suggest recommendations for increasing crop productivity and poverty reduction.

Materials and Methods

This study was conducted in 2007 based on cross sectional data collected during 2004-05 from mixed-cropping zone and rice-wheat cropping zone of Punjab. The study area was consisted of six districts; three from rice-wheat zone viz. Sialkot, Gujranwala and Sheikhupura and three from mixed-cropping zone viz. Faisalabad, Jhang and Toba Tek Singh. A multistage-cum-random sampling technique was used for this study. In first stage, three districts from rice-wheat zone viz. Sialkot, Sheikhupura and Gujranwala and three districts from mixed-cropping zone viz. Jhang, Toba Tek Singh and Faisalabad were selected. In second stage, one tehsil from each district was selected and in third stage one union council from each tehsil was chosen. In total 304 respondents (153 from rice-wheat zone and 151 from mixed-cropping zone) were randomly interviewed. Three questionnaires were dropped during data analysis due to incomplete information; thus total sample size was 301. An interviewing schedule was prepared for the collection of primary data through personal interviews on different variables affecting the livelihood of farmers e.g. income from different sources, production practices and input use for major crops etc.

Official poverty line of Pakistan was Rs.748.56 per adult equivalent per month based on 2000-01 prices. After adding up the changes in inflation from 2000-2004, the poverty line at 2004 prices was placed at Rs.848.78 per equivalent/month (GOP, 2004). Families with per capita income of less than Rs. 848.78 per month were considered poor and those with per capita income greater than Rs. 848.78 per month were considered as non-poor. Foster, Greer and Thorbeck (1984) class of poverty measures were applied for the analysis of primary data. The poverty measures related to this class were described as head-count ratio, poverty gap index and squared poverty gap.

Head-count ratio denoted by 'H' was based on poverty line that was established by costing a minimum basket of goods for basic human survival, using income or consumption data (Chaudhry, 1985). It was the proportion of population for which consumption (or another suitable measure of living standard) 'y' is less than poverty line 'z'. Suppose 'q' people are poor by this definition in a population of size 'n'. Then head-count index is

$H = q/n =$ proportion of total population deemed to be poor.

However, head-count index was totally insensitive to differences in the depth of poverty. Thus depth of poverty was measured by poverty-gap index (PGI). This was based on the aggregate poverty deficit of the poor relative to the poverty line. PGI gave a good indication of the depth of poverty, in that it measured the degree to which mean income of the poor differed from the established poverty line. To see how this measure was defined, let incomes be arranged in ascending order, the poorest has 'y₁', the next poorest 'y₂', etc., with the least poor having 'y_q'. Which was (by definition) no greater than the poverty line 'z'. Then the poverty gap index can be defined as follows:

$PG = 1/n \sum [(z-y_i)/z]^q =$ Mean proportionate poverty gap across the whole

$i=1$ population (zero gap for the non-poor)

But one drawback of the poverty gap measure was that it may not convincingly capture the difference in the severity of poverty. To determine this aspect of poverty, squared poverty gap index (P2) was used. It was measured by formula as:

$P_2 = 1/n \sum [(z-y_i)/z]^{2q} =$ mean of squared proportionate poverty gap

$i=1$

Both for descriptive and statistical analysis of the data, SPSS package was used.

Results and Discussion

Socio-economic Characteristics of the Farmers

Mean ages of the respondents in rice-wheat zone and mixed-cropping zone were 49 years and 42 years respectively. Farmers in rice-wheat zone were comparatively more experienced than in mixed-cropping zone. Mean experience of the farmers was 28 years in rice-wheat zone and 21 years in mixed-cropping zone. However, mean education of the respondents was same across the zones (8 years). Average family size of the sample farmers was thirteen and ten in rice-wheat and mixed-cropping zones respectively.

Tenancy characteristics of the farmers in the study area were quite similar across cropping zones, as 86% of the farmers were owner cultivators, 8% were owner-cum-tenants and 6% were tenants (Table 1). Poverty is strongly correlated with lack of land which is the principal asset in the rural economy of Pakistan (Anwar et al., 2004). Household assets, such as land ownership, value of livestock reduce the chance of being poor (Hashmi et al., 2008). Distribution of farmers by farm size categories was significantly different across the two zones. Percentage of the small farmers was same in both the zones (61%), whereas percentage of medium farmers was greater in mixed-cropping zone and that of large farmers was greater in the rice-wheat zone. Average operational holding of the farmers was 17.2 acres in rice-wheat zone and 14.2 acres in mixed-cropping zone (Table 1).

Sources of Income and Share of Different Crops in the Crop Income by Zone

Sources of income have great implication in determining the chances of any household being poor or otherwise. Malik (2005) defined five major sources of income in rural Pakistan viz. wages/salaries, transfer income, crop income, rental income and livestock income. In the surveyed zones, crop income contributed about two-third (66.4%) of the total income of the farm families while, about one-fifth (20%) is added by wages and salaries. Share of the livestock income was 7.5 per cent, while contribution of transfer and rental incomes was 3.7 per cent. Zone wise details of sources of income are given in Table 2.

Figures 1 to 4 show shares of major and minor crops in the total income of poor and non-poor farm families. In rice-wheat zone, share of minor crops in the income of non-poor farmers was greater (6%) than that of poor farmers (3%), see Fig. 1 and 2. In other words in rice-wheat zone, share of grain crops in the income of poor farmers was greater than non-poor ones. Similarly in mixed-cropping zone share of minor crop in the income of non-poor farmers was greater (29%) than that of poor farmers (8%), see Fig. 3 and 4).

(Rice-Wheat Zone)

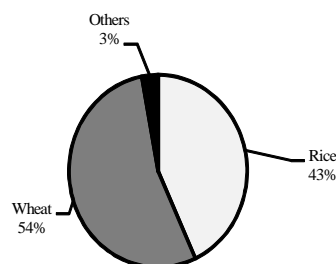


Fig. 1 Share of crops in the income of poor farmers

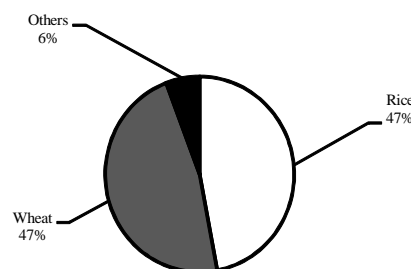


Fig. 2 Share of crops income in the income of non-poor farmers

(Mixed-Cropping Zone)

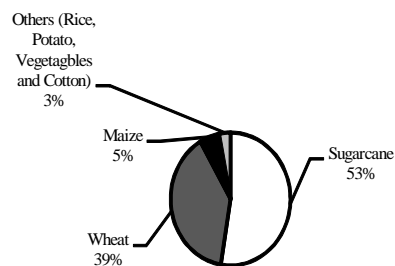


Fig. 3 Share of crops in the income of poor farmers

Due to lack of employment opportunities in the farm sector, share of non-farm income in the income of rural households is rising. Adams et al. (1995) observed that the non-farm sector was the most important source of income in rural areas of Pakistan, and indicated that self-employment, unskilled labour,

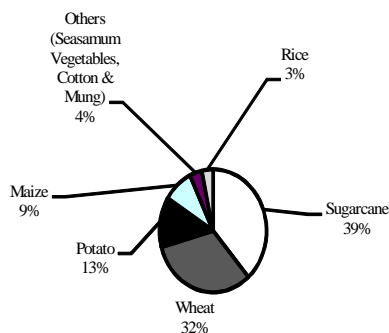


Fig. 4 Share of crops in the income of non-poor farmers

and government employment are three major sources of non-farm income. The World Bank (2002) also observed a high dependency on non-farm sources of income in rural Pakistan; about 44% of rural households were found to depend on non-farm sources of income in 2001. Wages and salaries are the significant income sources for farmers in the study area, as they contributed about one-fifth (20.4%) in total income of farm families. In rice-wheat zone, 20.0% families reported off-farm income sources (government employment, unskilled labour, and self-employment); while, in mixed-cropping zone 10.0% families reported to have off-farm income sources (government employment and unskilled labour).

Livestock sector also plays an important role in the income generation. Adam et al. (1995) declared it as an inequality-reducing source of income. A majority of poor households, especially land less or small landowners depend on livestock for income. Livestock contribution in the total income of the rural farm families was 5.1% in rice-wheat zone and 11.5% in mixed-cropping zone.

Rental and transfer incomes are the minor sources of earnings for farm families. In rice-wheat zone transfer income contributed 5.5% compared to 0.6% in mixed-cropping zone. Rental income contributions in total income of farm families were 1.9 % and 2.3% in rice- wheat zone and mixed-cropping zone were respectively (Table 2).

Poverty Indices

Head Count Ratio revealed that incidence of poverty was more widespread in mixed-cropping zone than in rice-wheat zone (see Table 3). In mixed-cropping zone 34% of the members of rural families were poor as compared to 28% in rice-wheat zone. On the overall basis, 31% per cent of the farm population was poor in the study area. Poverty-Gap Index revealed that mean income of poor farm households

was less than the established poverty line by 0.37 in the study area. The poverty gap index for mixed-cropping zone and rice-wheat zone were 0.41 and 0.14, respectively. Thus, aggregate poverty deficit of the poor was more in mixed- cropping zone than in rice-wheat zone. Squared Poverty Gap Index showed that income inequality amongst poor in mixed-cropping zone was more (1.46) than in rice-wheat zone (0.20). Thus poverty was more severe in mixed-cropping zone than in rice-wheat zone.

Agricultural Production

Identification of technologies by determining input use and yield levels was made to formulate recommendations to increase agricultural productivity of major crops. Most important factor in crop production is seed rate, as seed rate of any crop plays an important role in achieving the required plant population (Llovreas et al., 2004). Average seed rate used by the sugarcane farmers in the study area was 67.6 maunds per acre against the recommended rate of 80.0 maunds per acre. Recommended seed rate for growing nursery for one acre of rice crop is 4.5 kilograms. In mixed-cropping zone mean seed rate used by the farmers to grow rice nursery was equal to recommended level, while in rice-wheat zone it was less than the recommend level by about 0.8 kilograms. Mean seed rate for wheat crop was 50.1 and 46.7 kilogram per acre in mixed-cropping and rice-wheat zones respectively. Thus in the study area farmers were using recommended seed rate for wheat crop.

Similarly use of quality seed is one of the prerequisites for obtaining high yield. The information about the seed sources describes the role of various agencies in dispensing good quality seed to the farmers. Moreover, it helps in designing appropriate strategies to improve the existing seed distribution system. Farmers mostly use last year's crop produce as seed for sugarcane crop. In rice-wheat zone, most farmers (75.0%) reported to use last year produce for sowing sugarcane crop. However, in mixed-cropping zone, majority of the farmers (41.0%) reported to purchase sugarcane seed from seed dealers. Seed sources of the farmers for rice and wheat crops were significantly different across the two zones. In rice-wheat zone, most of the farmers (70.9%) reported to use last year's produce for raising rice nursery; while, in mixed-cropping zone, seed dealers were main source of seed as reported by the majority of the rice farmers (45.8%). In case of wheat, most of the farmers in rice-wheat zone (76%) and majority of the farmers (42%) in mixed-cropping zone reported to use last year's produce as seed. Details about seed sources by crop zones are given in Table 4.

Table 1 Tenancy status, farm size categorizes and operational holding of the sample respondents

Farm Characteristics	Rice-Wheat Zone	Mixed-Cropping Zone	Total	Significance
Tenancy Status (% farmers)				
Owner	84.9	86.8	85.5	0.872
Owner cum Tenant	8.6	7.9	8.2	
Tenant	6.6	5.3	5.9	
Farm Size Categorizes (acres)				
Small (<12.5)	61.2	60.9	61.1	0.007*
Medium (12.5-25)	16.4	27.8	22.1	
Large (>25)	22.4	11.3	16.8	
Operational Holding (acres)	17.2	14.2	15.7	

*Significant at 1% level

Table 2 Source of income of the respondents (%)

Agro-Climatic Zone	Crop Income	Wages & Salaries	Livestock Income	Transfer Income
Rice-Wheat	71.0	16.5	5.1	5.5
Mixed-Cropping	58.6	27.0	11.5	0.6
Total	66.4	20.4	7.5	3.7

Table 3 Poverty Indices

Poverty Indices	Rice-Wheat Zone	Mixed-Cropping Zone	Total
Head Count Ratio (%)	28	34	31
Poverty-Gap Index	0.14	0.41	0.37
Squared Poverty Gap Index	0.20	1.46	-

Table 4 Seed sources of major crops by zone (% Farmers)

Crops	Rice-Wheat Zone	Mixed-Cropping Zone	Total	Sig.
Sugarcane				
Agri. Research Station	0.0	13.1	12.2	0.215
Fellow Farmers	12.5	10.3	10.4	
Seed Dealers	12.5	41.07	39.15	
Last Year's Produce	75.0	35.52	38.24	
Rice				
Punjab Seed Corporation	1.4	0.0	1.10	0.000*
Agri. Research Station	1.4	16.7	5.3	
Seed dealers	22.8	45.8	28.6	
Fellow farmers	3.5	8.3	4.8	
Last Year's Produce	70.9	29.2	60.3	
Wheat				
Punjab Seed Corporation	1.42	0.00	0.7	0.000*
Agri. Research Station	0.00	18.1	9.1	
Seed dealers	16.62	33.4	25.0	
Fellow farmers	6.28	6.2	6.2	
Last Year's Produce	75.68	42.3	59.0	

*Significant at 1% level

Fertilizer application levels for major crops were significantly different across the two zones; however, use of phosphorus for rice crop was quite same across both zones. Moreover, mean application of nutrients for wheat crop were also similar across zone. Average applications of fertilizer nutrients for sugarcane and rice crops were relatively higher in mixed-cropping zone as compared to rice-wheat-zone. Farmers were applying imbalanced and low level of fertilizers in the study area.

On the whole, per cent gaps between the recommended and actual levels of fertilizer nutrients applications were 42, 47 and 62 per cent for wheat, rice and sugarcane crops respectively. The mean application of nitrogen, phosphorus and potash by sugarcane growers was 51.4, 20.1 and 0.8 kilogram per acre against the recommended levels of 92, 46 and 50 kilograms per acre respectively. Mean applications of nitrogen, phosphorus and potash for the rice crop were 40.7, 17.7

Table 5 Fertilizer use in major crops by cropping zones (kgs/Ac)

Crops	Rice-Wheat Zone	Mixed-Cropping Zone	Total	Sig.
<i>Sugarcane</i>				
Nitrogen	31.8	53.0	51.4	0.015*
Phosphorus	19.2	20.1	20.1	0.001*
Potash	0.0	1.1	0.8	-
<i>Rice</i>				
Nitrogen	38.6	46.9	40.7	0.055**
Phosphorus	16.7	21.4	17.7	0.349
Potash	0.8	0.7	0.7	-
<i>Wheat</i>				
Nitrogen	51.7	50.8	51.5	0.015*
Phosphorus	25.1	26.9	26.0	0.002*
Potash	0.4	0.3	0.4	-

* and ** are significant at 1% and 5% levels, respectively.

Table 6 Gaps between obtained and potential yields

Crops	Yield Obtained (<i>Maunds/Ac</i>)			Potential Yield (<i>Maunds/Ac</i>)	Yield Gap (%)			Sig.
	Rice- Wheat	Mixed- Cropping	All Zones		Rice- Wheat	Mixed- cropping	All Zones	
Rice	35.5	36.4	35.7	72.0	50.7	49.4	50.4	0.704
Sugarcane	650.0	707.7	706.1	1082.0	39.9	34.6	34.7	0.000*
Wheat	35.6	35.7	35.7	60.0	40.7	40.5	40.5	0.029**

* and ** are significant at 1% and 5% levels, respectively.

phosphorus and potash by sugarcane growers was 51.4, 20.1 and 0.8 kilogram per acre against the recommended levels of 92, 46 and 50 kilograms per acre respectively. Mean applications of nitrogen, phosphorus and potash for the rice crop were 40.7, 17.7 and 0.8 kilogram per acre against the recommended dosages of 55, 32 and 25 kilograms per acre respectively. Average usages of N, P and K fertilizers for wheat crop were 51.5, 26.0 and 0.4 kilograms per acre against the recommended dosages of 64, 46 and 25 kilogram per acre respectively (Table 5). Thus, farmers apply low doses of fertilizers to major crops in both the cropping zones. Main reasons to use low levels of fertilizers reported by the farmers were non-availability/ black marketing and high prices of fertilizers especially at sowing times.

Mean sugarcane yield obtained by the farmers in mixed-cropping zone was relatively higher as compared to farmers of rice-wheat zone. Average yield of sugarcane in the study area was 706.1 maunds per acre, which was less than potential yield of 1082 maunds per acre by 34.7 per cent. Average yield of rice crop was 35.7 maunds per acre and yield gap for rice crop was 50.4 per cent. Average yield of wheat obtained by the growers in the study area was 35.7 maunds per acre which was less than the potential yield by 40.5 per cent.

Conclusion and Recommendations

Almost one-third of farm population was poor in the study area. Poverty was more widespread in mixed-cropping zone than in rice-wheat zone. Aggregate poverty deficit of poor in mixed-cropping zone was more than in rice-wheat zone. Likewise, poverty was more severe in mixed-cropping zone than in rice-wheat zone. Incidence of poverty was more in mixed-cropping zone than in rice-wheat zone in spite of use of better quality seed and application of higher dosages of fertilizers by the farmers in this zone than in rice-wheat zone. There are many reasons for this; yield of major crop was quite similar across both zones, percentage of the large farmers and mean holding of the sample farmers was greater in rice-wheat zone than in mixed-cropping zone, share of crop income in the total family income was greater in rice-wheat zone than in mixed-cropping zone. Moreover, incidence of poverty not only depends on the land ownership but also on many other factors viz. quality of land and its productivity, availability of water fit for irrigation, dependency ratio, income diversification and transfer incomes etc. In the study area, crop yield gaps between actual and potential ones were 35-50 per cent. Main reasons of low yields were less than recommended seed use, imbalanced and less than recommended application of fertilizers, high prices of agricultural inputs and adulterated agro-chemicals etc. On the output side, low prices of

the produce, lack of transportation and storage facilities were perceived as main problems by the farmers. As the crop income contributes about two-third in the total income of farm families; thus increase in agricultural productivity is essential for increasing crop earnings of the farmers and to lower the rural poverty in the province. Since the increasing prices of agricultural inputs have eroded farmers' purchasing power, thus they have chosen to cut on inputs use. To improve the situation, authorities should strictly penalize hoarders of fertilizers and control overpricing of fertilizers and agro-chemicals. This is necessary to transfer the subsidies provided to the fertilizer companies by the government to the farmers in a real sense.

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